WASHINGTON
SCIENCE TRENDS

HIGHLIGHTS

* ELECTRICAL ENCAPSULATION
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* PUBLICATION CHECKLIST

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* ELECTRICAL ENCAPSULATION PROGRESS

Department of Defense experts believe that important contributions have recently been made in the technology of encapsulating electrical components in polymeric casting resins, although further research and development is required in a number of allied fields.

Materials currently being used include epoxy, polyester, polysulfide, silicone, polyurethane and hydrocarbon.

A Defense Department survey shows that most of the recent resin developments have been in the epoxy and silicone fields. Epoxy-based formulations are the most widely used materials, and with polyester resins they constitute the rigid-type material.

Silicones cost more than the other materials, but have better temperature capabilities.

Polysulfides and polyurethanes have found their largest use in sealing-type applications (cables, connectors) but there are indications that the polyurethanes will increase in popularity at the expense of other materials because of their combination of properties -- toughness, thermal shock resistance flexibility and cold-flow resistance.

Test methods are becoming more sophisticated. Advances in electrical testing techniques have been largely due to use of sensing devices encapsulated in the resin, and the determination of parameters both during and after resin hardening. Instrumentation has been reported for determining the existence and magnitude of thermal stresses in casting resins during and after cure; electrical properties, thermodynamic properties such as rate of polymerization and other factors.

Further improvements, particularly for military applications, are required for:

✓ High temperature stability
✓ Wide temperature-range usefulness
✓ Thermal shock resistance
✓ Improved electrical properties over a wide temperature and frequency range
✓ Radiation resistance
✓ Low-loss casting materials with improved processing properties.

(A summary of research and development in these fields, references for further reading and a list of suppliers is now available in Plastec Report No. 3, (PB 171 034) available through military channels or for sale in the near future by OTS, U. S. Department of Commerce, Washington 25, D. C.)

* "Nickel and Dime" Space Failures

The U. S. space program has been "riddled with failures traceable to nickel and dime parts that let us down", according to W. A. Fleming, Assistant Administrator, National Aeronautics and Space Administration. His comments underscore increased future reliance on reliability and more adequate pre-launch checkouts.

ø Solder in the Diodes -- In one instance, it is reported, authorities traced the loss of a multi-million dollar launch vehicle and its costly payload to a loose piece of solder within a small diode. Fleming reports:

"Upon X-ray examination of the supplier's inventory of these diodes we found that nearly every one contained a loose piece of solder. A further check revealed that these diodes and the one in the doomed launch vehicle were part of a bad run. The supplier had relaxed his quality control and a bad run of diodes resulted. What made the matter even worse is that the supplier had not been informed as to what use his diodes would be put, and therefore proper testing procedures were not established. Neither were the vehicle checkout procedures adequate to catch this fault."

ø Reliability Goals -- Here are the steps outlined by the NASA official in a program which would reduce launch site checkout time from the present six weeks to a maximum of six days:

✓ Vehicles should be increasingly designed with simplicity and reliability in mind. Simplicity is the keynote to reliable and economical fabrication.

✓ Checkout lines in the hangers at Cape Canaveral, where vehicles are now often taken apart for checking and rebuilt, must be replaced by in-plant testing and checkout procedures. Each launch vehicle must be complete in every detail -- totally checked out and ready for installation on the launch pad -- before it is permitted to pass out through the doors of the contractors plant.

✓ New automatic checkout techniques, such as those being developed for the Saturn program, must be developed for use on the launch pad. The many days of tedious manual checking by the field crew must be replaced with a few hours of checkout using automatic testing equipment.

Other comments on reliability this week:

✓ "If we analyze how living mechanisms operate, we see that although they can be damaged, in the majority of cases, operation is still possible. While this means degraded functioning, if the threshold is high enough, it is operational none-the-less. This philosophy can mean significant improvement in the total reliability of our missile and space systems.... Reliability must take on a new meaning. We are interested in satellite systems having an 8000-hour operational life with zero maintenance. This will place heavy demands on industry, both in the areas of miniaturization and reliability..." ---Lt. Gen. B. A. Schriever, Commander, Air Research and Development Command, U. S. Air Force.

✓ "If a satellite now weighing, say, five hundred pounds were to be replaced by five satellites of about one hundred pounds each, much less expensive boosters could be used. The cost of launching in dollars per pound of payload at the pad might well remain the same. It may even be a small percentage greater. But--until we can guarantee one hundred percent success in getting into orbit, we can be reasonably sure that the dollars per pound in orbit will be less. This will be true even though we limit the tasks per satellite so that no two of the five in our example have overlapping assignments..." -- Rear Adm. J. A. Jaap, Director, Development Programs, Office of the Chief of Naval Operations.

* SPECIAL SUMMARY REPORT -- U. S. Army Aircraft

Here, for reference and future guidance, is the latest official summary of U. S. Army Aircraft. This program is steadily growing in importance as Navy and Air Force aircraft procurement continues to decline:

FIXED WING

□ L-19A "Bird Dog" -- An observation type airplane used primarily by Infantry, Artillery and Armored units. This is the Army's standard fixed-wing light observation class aircraft. Equipped with flaps, fixed landing gear and steerable tail wheel to permit maximum efficient operation from small, unimproved landing fields in the immediate vicinity of troops engaged in combat. The BIRD DOG has a speed of 86 knots and the range is 400 miles. Powered by a six cylinder horizontally opposed piston type engine, has a wing span of 36 feet, is 25 feet long and 9.2 feet high. Carries a pilot and one observer passenger. Manufactured by Cessna Aircraft Company, Wichita, Kansas.

□ L-20 "Beaver" -- A utility type airplane employed at division and higher headquarters to expedite and improve ground combat in the combat zone. This is the Army's standard fixed-wing utility class aircraft. This rugged airplane has extremely large wing surfaces, incorporates flaps, fixed landing gear and steerable tail wheel to permit maximum efficient operation from short unimproved landing fields. Carries a pilot and five passengers; pilot, three litter patients, and a medical attendant, or pilot and approximately 1000 pounds of cargo. Its speed is 97 knots and the range is 500 miles. Powered by a nine cylinder radial piston type engine, has a wing span of 48 feet, is 30.3 feet long and 10.4 feet high. Manufactured by DeHavilland Aircraft of Canada, Limited, Toronto, Canada.

□ L-23D "Seminole" -- A utility transport type twin-engine airplane employed at corps or higher headquarters level for the accomplishment of command, liaison and courier missions pertinent to combat zone and training. This is the Army's standard fixed-wing utility transport class aircraft. This reliable twin-engine aircraft equipped with flaps and retractable tricycle landing gear is a remarkable performer from relatively short, improved landing fields. Carries a pilot and five passengers, is capable of long range all-weather flying and can be flown safely on one engine in case of emergency. Its speed is 139 knots and its range is 800 miles. A newer model, the L-23F, is now being procured to fill the same mission. The "F" model has a different seating arrangement than the "D" and can be easily converted to a litter or high priority cargo configuration. Manufactured by Beech Aircraft Corporation of Wichita.

□ U-1A "Otter" -- Assigned to Army Corps of Engineer units to assist in the conduct of topographic operations, the U-1A is also assigned to fixed-wing tactical transportation companies in quantities of 16 per company to expedite and improve ground combat in combat zone. A rugged airplane, it has extremely large wing surfaces, incorporates flaps, droop ailerons, fixed landing gear and steerable tail wheel to permit maximum efficient operation from short unimproved fields. Carries a pilot and ten fully equipped troops, or pilot and approximately 2000 pounds of cargo, or pilot and six litter patients. Powered by a nine cylinder radial piston type engine, has a wing span of 58 feet, is 41 feet and 10 inches long and 12 feet 7 inches high. Manufactured by DeHavilland Aircraft of Canada Limited, Toronto.

* SPECIAL SUMMARY REPORT -- U. S. Army Aircraft (Continued)

□ AC-1 "Caribou" -- A new transport airplane being procured to replace the "Otter". This is a twin-engine, multi-passenger aircraft capable of carrying 32 troops or three tons of equipment during air mobile operations and suitable for use as a supply carrier within the field Army air line of communications area during day, night or under instrument conditions. This aircraft, now being tested, will be assigned to company sized units normally operating at Corps and Field Army level and may be operated from unprepared fields or hastily prepared strips in combat thus complementing the HC-1 in its mission as a member of the VTOL/STOL transport team. Manufactured by DeHavilland Aircraft of Canada Limited, Toronto, Canada.

□ AO-1 "Mohawk" -- A twin turbo-prop engine, fixed wing airplane featuring maximum maintainability, rugged construction, visibility, short take-off and landing characteristics and capable of day, night and instrument operation. This aircraft, now being tested, is designed to pentrate enemy-held territory for the purpose of seeking targets and information of the enemy by visual, photographic and electronic sensory means. Manufactured by Grumman, Bethpage, L. I.

ARMY AVIATION HELICOPTERS

□ H-13 "Sioux" -- A single-engine helicopter incorporating a two blade main rotor and two blade tail rotor with conventional control system, the H-13 is the Army's standard observation class helicopter. Used extensively at the Army Aviation School, Fort Rucker, Alabama, as a primary helicopter flight trainer, and by combat units for reconnaissance, emergency medical evacuation, command liaison, wire laying, and resupply in the combat zone and training therefor. It has an open configuration type fuselage with bubble-type cockpit, skid-type landing gear with ground handling wheels installed and provisions for attaching two litter pods on the landing gear cross tubes outside the aircraft. Carries a pilot and passenger inside, or pilot and two litter patients. Its speed is 59 knots and has a range of 125 miles. Powered by a vertically mounted six cylinder horizontally opposed piston type engine; has a rotor diameter of 35.1 feet, 41.4 feet long, 9.5 feet high, and 8.6 feet wide. Manufactured by Bell Aircraft Corporation, Fort Worth, Texas.

□ H-19 "Chickasaw" -- This is the Army's standard utility class helicopter. It is a single-engine helicopter incorporating a three blade main rotor and two blade tail rotor. Used extensively by combat units to transport supplies, equipment, personnel, small units, and for aero-medical evacuation in the combat zone. Carries a pilot, co-pilot and seven passengers; pilot, co-pilot and six litter patients, or about 1800 pounds of cargo. Its speed is 80 knots and range is 200 miles. Powered by a nine cylinder radial piston type engine mounted in the nose and inclined aft 35 degrees. Main rotor diameter of 53 feet, 62.3 feet long, 46.1 feet wide and 15.3 feet high. Manufactured by Sikorsky Aircraft Division, United Aircraft Corporation, Bridgeport, Connecticut.

□ HU-1a "Iroquois" -- A single turbo-shaft engine helicopter stressing maximum mobility features including aero-medical aviation; low-silhouette; air transportability; 8-10 passenger; internal and external cargo capability, and day, night and instrument operation. This helicopter is designed to perform air cavalry missions or suppressive fire missions as a weapons carrier, carry troops and supplies during air mobile operations and perform all types of utility, command, liaison, communications and aero-medical evacuation missions primarily at division and corps levels. Manufactured by Bell Helicopter Company, Fort Worth, Texas.

* SPECIAL SUMMARY REPORT -- U. S. Army Aircraft (Continued)

□ H-21 "Shawnee" -- A large single-engine helicopter, the H-21, like the H-34, is one of the Army's two standard light transport class helicopters. It is assigned primarily to Transportation Helicopter companies and used to transport supplies, equipment, personnel, small units, and for aero-medical evacuation within the combat zone. The H-21 has won acclaim with the Army in accomplishments while participating in civil disaster operations and world record-breaking endurance flights. It is powered by a 9 cylinder, radial, piston type engine. It is equipped with two main loading doors, has a rotor diameter of 44 feet, is 86.3 feet long, 39 feet wide and 15.4 feet high overall. Carries a pilot, co-pilot, and from 10 to 20 troops, depending upon the equipment they carry and distance to be hauled; pilot, co-pilot and 12 litter patients, or pilot, co-pilot and about 3000 pounds of cargo. Its maximum speed is over 100 knots and its range 200 miles. Manufactured by Vertol of Morton, Pa.

□ H-23 "Raven" -- A single-engine helicopter, the H-23 is an observation class helicopter. Used extensively by the Army as a helicopter pilot primary flight trainer, the aircraft is also assigned to some Engineer Corps units as well as Reserve component and non-combatant units of the Army in continental United States. Powered by a vertically mounted 6 cylinder horizontally opposed piston type engine and has a rotor diameter of 35 feet, is 40.5 feet long, 9.8 feet high, and 10 feet wide. Used for reconnaissance, evacuation of wounded, command liaison, wire laying and resupply. Carries a pilot and passenger inside or pilot and two litter patients in pods attached to cross tubes outside of aircraft. Speed is 59 knots and range is 125 miles. Manufactured by Hiller of Palo Alto, California.

□ H-34 "Choctaw" -- The H-34 is one of the Army's two standard light transport class helicopters. Assigned primarily to Transportation Helicopter companies and used to transport supplies, equipment, personnel, small units, and for aero-medical evacuation within the combat zone. It is a large single-engine, all metal helicopter. Won acclaim in 1956 when Army aviators established three world helicopter speed records over a closed course at Bridgeport, Connecticut. Powered by a 9 cylinder radial, piston type engine mounted in the nose, facing aft, and inclined 35 degrees from horizontal. It incorporates a single cabin door for loading, has a rotor diameter of 56 feet, is 65.8 feet long, 40 feet wide and 15.9 feet high overall. Carries a pilot, co-pilot and from 10 to 18 troops depending upon the equipment they carry and distance to be hauled, or pilot, co-pilot and about 3000 pounds of cargo. Maximum speed is over 100 knots and range is 200 miles. Manufactured by Sikorsky of Bridgeport, Connecticut.

□ H-37 "Mojave" -- A giant twin-engine all metal helicopter, incorporating a five blade main rotor and four blade tail rotor, the H-37 is the Army's standard medium transport class helicopter. This machine is designed for tactical transport and cargo operation. Transportation Helicopter companies use these aircraft. Powered by two 18 cylinder twin-row, radial piston type engines mounted in nacelles at the tips of a short high wing. Largest helicopter in the Army inventory. Fuel is carried in wing and nacelle tanks. Lower portion of the nose of the fuselage consists of "clam shell" type cargo loading doors and a cargo loading ramp. Can accommodate 36 fully equipped troops, 24 litters, or equipment up to a 105mm howitzer, plus one-quarter ton trailer inside its fuselage. Instead of these internal loads can carry up to 10,000 pounds of cargo in an external sling which may be attached to the floor of the fuselage. Manufactured by Sikorsky, Bridgeport, Connecticut.

* SPECIAL SUMMARY REPORT -- U. S. Army Aircraft (Continued)

□ HC-1 "CHINOOK" -- A twin turbo-shaft engine, multi-passenger helicopter capable of carrying cargo loads internally up to three tons and externally over six tons for short distances. It will transport troops and their equipment in mass formation during air mobile operations, perform emergency evacuation of wounded in litter configuration and perform other transport missions on the battlefield where prepared landing areas are not available. This helicopter, now being developed, will be assigned to company size aviation units normally operating at the corps and field army level. The transport helicopter will be capable of operations during day, night and under instrument conditions. Manufactured by Vertol Division of Boeing Aircraft, Morton, Pennsylvania.

* ONR STUDY GROUP FINAL REPORT ON MICROELECTRONICS

Increased Navy support of microminiaturization electronic research, creation of a permanent panel to coordinate Army, Navy, Air Force and industry microminiaturization efforts and greater Navy in-house effort in this field are three of the major recommendations contained in the final report of an ONR study group on microelectronics. Last year, the Navy's research and development program in this field amounted to less than $1.5 million and this apparently will be increased. The study group report summarized all of the Navy work in the field and most of the work being done by the other services and then outlined the state-of-the-art in all of the major problem areas. The technical comments involved the following systems categories:

Technique	Equivalent Parts/cu ft
World War II (miniature tubes)	10^3
VT Fuze (subminiature tubes)	10^4
Present (transistors)	10^4
Present (special "hearing-aid" construction)	10^5
Packaging (micro-module)	2×10^5 -10^6
Integrated Circuit (ceramic substrate)	less than 10^6
Integrated Circuit (semiconductor substrate)	less than 10^7
Functional Blocks	less than 10^8

The packaging technique is expected to play a part in the design of operational military electronic equipment during the next few years and the study group urged greater research efforts in the last three categories to insure the improvement of electronic systems after 1970.

("Final Report of ONR Study Group on Microelectronics", long delayed by Government red tape is now available through military channels or at 50 cents from OTS, U. S. Department of Commerce, Washington 25, D. C.)

* THERMOCOUPLE CALIBRATION

The National Bureau of Standards is providing services by which thermocouples are calibrated over the temperature range of -190° to + 1100°C for laboratories, industrial concerns and various research groups, on a fee basis. Allied services include calibration of thermocouple materials to determine the voltages they produce when fused to a standard platinum wire, and determination of the accuracy of potentiometers used in thermoelectric measurements. -- Samples of freezing point standards -- aluminum, copper, lead, zinc and tin are available to the public on a fee basis.

(For details, write National Bureau of Standards, Office of Technical Information, Washington 25, D. C.

TECHNICAL TRENDS

□ Information on Fullbright advanced research and university lecturing fellowships in the Pacific, Asia and Latin America may be obtained from Committee on International Exchange of Persons, National Academy of Sciences, Washington 25, D. C. Deadline is April 25, 1961. √√√ A one-day meeting will be held June 29, 1961, on High Precision Connectors in coaxial equipment for radio and microwave frequencies. For details, write R. C. Powell, National Bureau of Standards, Boulder, Colorado. √√√ Details on distribution of technical reports on the new field of Pure Fluid Amplification can be obtained from R. E. Bowles, Chief, Non-Radio Systems Branch, Diamond Ordnance Fuze Laboratories, Washington 25, D. C.

□ Tests by the Air Materiel Command indicated almost 100 percent effectiveness for tail hooks to prevent emergency landing accidents on F-101 and F-102 aircraft. The entire NORAD F-102 fleet will be so equipped by the Fall of this year. √√√ Ryan Aeronautical Co., San Diego, expects to flight test shortly a new Parawing or "Flex Wing" manned aircraft under an Army Transportation Research Command contract. (SCIENCE TRENDS, Nov. 21, 1960). √√√ Information on the award of 1,537 Graduate Fellowships in the sciences, mathematics and engineering for the Academic Year 1961-1962 is contained in Announcement NSF 61-113, Information Office, National Science Foundation, Washington 25, D. C. √√√ Organizations interested in installing VHF-UHF television broadcast receivers at 1,000 test locations in the New York City Area have until April 5, 1961 to submit proposals to the Chief, Administrative Services Division, FCC, Washington 25, D. C.

□ Reorganization of the Atomic Energy Commission, to place more emphasis on the authority of the Commissioners, has begun. First step is the appointment of Harold L. Price as Acting Director of Regulation -- to report directly to the Commission. √√√ The Naval Ordnance Laboratory, White Oak, Silver Spring, Md. has drawn up long-range plans for a large hydroballistic facility, said to be required for studying the phenomena of water exit and entry and underwater launching trajectory problems for underwater missiles. √√√ The Department of Defense hopes to save $5 million annually through a Navy devised system in which digital computers are used to analyze complex bids from companies competing in the sale of jet fuel.

□ Polaris-carrying nuclear submarines are now carrying all engineering drawings of their ballistic missile system on microfilm aperture cards. The system, combined with a reader-printer, is said to be economical both in time, and storage space. √√√ The Office of Naval Research, Washington 25, D. C. is interested in hearing from firms with capabilities in advanced computer design and information theory, including the structure and operation of automatic data processing systems, filtering, prediction and feedback techniques and signal-noise problems. Detailed information on your organization should be sent to ONR, ATTN: Code 402S.

ROYALTY-FREE PATENT

The following invention, developed at U. S. Government expense, is now available to U. S. Industry, royalty-free. For Patent Number, and details on licensing subscribers may write Service Department, Washington SCIENCE TRENDS, National Press Building, Washington 4, D. C.

□ Level Indicating Device -- The patent covers a position indicating device which provides a stabilized platform on an aircraft, guided missile, ship or land vehicle for supporting a compass, camera, pith or roll detector or other instrument. The device which indicates changes of level, plumbline or acceleration consists of a force-sensitive reciprocable element that is highly sensitive to changes of force on it, but after its initial quick movement, it is rapidly damped. An air bearing is employed with chambers at the ends of a reciprocable element for damping by compressed gas.

P U B L I C A T I O N C H E C K L I S T

- ☐ TITANIUM ALLOYS, a compilation and review of design information for the commercially important titanium alloys in aircraft and missile applications. 84 pages. Single copies free to Government agencies, contractors, subcontractors and their suppliers. (Write Defense Metals Information Center, Battelle Memorial Institute, Columbus 1, Ohio regarding DMIC Report No. 145)

- ☐ PATENT SEARCHES, a research and development report on a relatively new U. S. Patent Office program for conducting mechanized searches in the field of organic phosphorous compounds. 23 Pages. 25 Cents. (Write Publications Office, U. S. Department of Commerce, Washington 25, D. C. regarding Patent Office Research and Development Report No. 18)

- ☐ CHEMICAL INDUSTRY IN EUROPE, a review of the overall picture of the European chemical industry. Detailed studies of ten major sectors including basic chemicals; petrochemicals, dyestuffs, plastics, and photographic supplies. 208 Pages. $3. (Write OEEC Mission Publications Office, 1346 Connecticut Avenue, N. W., Washington 6, D. C. for "Chemical Industry in Europe, 1959-1960")

- ☐ CATHODE RAY STORAGE TUBES, a literature survey by Lockheed Aircraft Corp. covering work at a number of locations on cathode ray storage tubes and published from late 1947 through 1959. 33 Pages. (Available as PB 171 127 through military channels or at $1 from OTS, U. S. Department of Commerce, Washington 25, D. C.)

- ☐ INSTRUMENT FLYING, a Defense Department manual establishing standard instrument flying techniques and procedures for the operation of all fixed-wing aircraft. Includes data on flight instruments and systems, navigation aids and procedures. 228 Pages. $2.25. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Publication No. D 301. 7:51-37/3)

- ☐ USSR MISSILES, ROCKETS AND SPACE EFFORT, an Army bibliography covering information on Soviet rocketry from rocket bases and installations to "Missile Diplomacy" during the period 1956-60. 49 Pages. 15 Cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Publication No. D. 101.22:715-3/2)

- ☐ LIQUID HYDROGEN HANDLING, a report for the Air Force on the hazards of producing and storing liquid hydrogen and safer ways for handling this high energy space age fuel. Includes a "stored quantity -- safe storage distance table" believed to be unique. Single Copies Free. (Write Publications-Distribution Section, U. S. Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa. for Report of Investigation No. 5707)

- ☐ INDUSTRIAL RAW MATERIALS, a survey which projects for the next two decades the consumption of 46 principal industrial materials against their available supply in North America. Covers mineral fuels, non-fuel minerals, forest products, raw materials from the sea and the atmosphere. 76 Pages. $2. (Write National Planning Association, 1606 New Hampshire Avenue, N. W., Washington 9, D. C.)

- ☐ MAJOR ACTIVITIES IN THE ATOMIC ENERGY PROGRAMS, the Annual report for 1960 of the Atomic Energy Commission, containing a wide variety of information on programs and developments. 539 Pages. $1.75. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for AEC Annual Report-1960)